REMARKS

Claims 1-31, 52, and 54-59 are pending in the application. Applicant expresses appreciation for the allowance of claims 56-59 and for the indication that claims 10-12 and 28 set forth allowable subject matter.

Claims 1-4, 6-8, 13-15, 18-20, 23-26, 29-31, 52, 54, and 55 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Bai in view of Callegari. Applicant requests reconsideration.

Claim 1 sets forth a method of forming a dielectric layer that includes, among other features, forming a first metal-containing dielectric layer consisting of metal oxide over a silicon-containing surface and forming a second metal-containing dielectric layer consisting of metal oxide on and in contact with the first metal-containing dielectric layer. All of the metal of the first dielectric layer consists of at least one element selected from Group IVB and all the metal of the second dielectric layer consists of at least one element selected from Group IIIB. Pages 2-3 of the Office Action allege that Bai discloses every limitation of claim 1 except for all the metal of the second dielectric layer consisting of at least one element from Group IIIB and relies upon Callegari as allegedly disclosing the missing subject matter. Applicant traverses.

Page 3 of the Office Action alleges that column 4, lines 47-67 of Callegari disclose that dielectric material 14 may be La_2O_3, BST, or PZT. The Office Action thus concludes that it would be obvious to a person of ordinary skill to replace the BST or PZT of top dielectric layer 120 in Bai with La_2O_3. The Office alleges that such material substitution would be a mere substitution of art-recognized equivalent values.

Applicant asserts that obviousness can be established by a combination of references, but not unless there is some motivation in the art to support the combination. See, ACH Hospital Systems, Inc. v. Montifior Hospital, 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984) ("Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination"). Also, the mere fact that the prior art can be modified does not make the modification obvious "unless the prior art suggested the desirability of the modification." In re Gordon, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). Accordingly, if a proposed modification of the prior art would render the prior art device or process "inoperable for its intended purpose," then no suggestion or motivation exists to make the proposed modification. Id.; MPEP § 2143.01.

Applicant notes that paragraphs [0019] and [0026] of Bai describe that the function of top dielectric layer 120 is to block any leakage current through bottom dielectric layer 130. Notably, the composition of bottom dielectric layer includes, among other materials, La_2O_3. Accordingly then, the BST or PZT in top dielectric layer 120 is used to block leakage current through La_2O_3, or other materials, forming bottom dielectric layer 130. Since BST or PZT is needed to block leakage current through La_2O_3 when it is used as bottom dielectric layer 130, it follows that using La_2O_3 as top dielectric layer 120 when bottom dielectric layer 130 includes HfO_2 will not provide the desired function for top dielectric layer 120.

It is clear from the express text of Bai that La_2O_3 is not a suitable replacement for BST or PZT in top dielectric layer 120. Substitution of such materials with La_2O_3 will frustrate the intended purpose of top dielectric layer 120 to function as a block to leakage current through bottom dielectric layer 130. Accordingly, regardless of any teachings in Callegari that such materials can be substituted, Bai clearly teaches that substitution is improper for the Bai device shown in Fig. 1 and described in the corresponding text. At least for such reason, Applicant asserts that combination of the cited references is improper.

Claims 2, 6-8, 13-15, 18, and 19 depend from claim 1 and are patentable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested. For example, claim 8 sets forth that forming the first metal-containing and second metal-containing dielectric layers includes, among other features, forming a hafnium-containing layer, forming a lanthanum-containing layer over the hafnium-containing layer, and exposing the hafnium-containing and lanthanum-containing layers to an oxygen comprising atmosphere. The method includes heating the layers to a temperature effective to form a hafnium-containing dielectric layer and a lanthanum-containing dielectric layer. Pages 4-5 of the Office Action acknowledge that Bai does not disclose forming the metal-containing layers, exposing them to oxygen, and heating them to form dielectric layers, as set forth in claim 8. However, the Office Action alleges that Callegari discloses the claim limitations.

The Office Action refers to column 2, lines 50-65 as supporting such allegation. However, the referenced text pertains merely to depositing a layer of polysilicon. That

is, Callegari does not disclose or suggest forming hafnium-containing and lanthanum-containing layers and exposing them to an oxygen comprising atmosphere. Column 2, lines 50-65 of Callegari do not provide any mention of oxygen exposure. Instead, such text describes depositing a layer of polysilicon at a temperature of from about 350° to about 750° C. It follows that since polysilicon is the desired material to be deposited, oxygen will not be present in the deposition reactor chamber. "Si-containing precursor gas" used to deposit the polysilicon is defined in column 2, lines 41-43 merely as containing silicon and hydrogen. Accordingly, column 2, lines 50-65 and the remainder of Callegari do not disclose or suggest exposing a hafnium-containing and lanthanum-containing layer to an oxygen comprising atmosphere, as set forth in claim 8. At least for such reason, Callegari fails to disclose or suggest the subject matter alleged by the Office Action.

In addition, Callegari does not disclose or suggest heating the hafnium-containing and lanthanum-containing layers to a temperature effective to form hafnium-containing and lanthanum-containing dielectric layers. Column 2, lines 50-65 of Callegari merely describe heating "high-k dielectric material" to a temperature of 350° to 750° C. Such text cannot be considered to disclose heating hafnium-containing and lanthanum-containing layers to a temperature effective to form dielectric layers since the material heated in Callegari is already a dielectric material. Callegari does not contain any disclosure or suggestion of "a temperature effective to form" a dielectric layer. Callegari merely describes heating a dielectric layer and depositing polysilicon thereon. A person of ordinary skill viewing the teachings of Callegari would not derive

therefrom any suggestion of a temperature effective to form hafnium-containing and lanthanum-containing dielectric layers from hafnium-containing and lanthanum-containing layers in an oxygen comprising atmosphere. At least for such additional reason, Callegari fails to disclose or suggest the subject matter alleged by the Office Action. Claim 8 is thus patentable over the cited combination of references.

Claim 20 sets forth a method for forming a MOS transistor including, among other features, forming a hafnium-containing dielectric layer consisting of hafnium oxide on and in contact with a surface comprising silicon, forming a lanthanum-containing dielectric layer on and in contact with the hafnium-containing dielectric layer, and forming a gate electrode over the hafnium-containing and lanthanum-containing dielectric layers. Forming the hafnium-containing dielectric layer includes initially forming a hafnium-containing metal layer. Also, forming the lanthanum-containing dielectric layer includes initially forming a lanthanum-containing metal layer. Page 5 of the Office Action alleges that Ota and Callegari disclose all the limitations of claim 20. Applicant presumes that reference to Ota is a typographical error and that the Office intended to reference Bai. As may be appreciated from the discussion above regarding the deficiencies of Bai and Callegari as applied to claim 1, the cited combination of references fails to disclose or suggest every limitation of claim 20. For example, replacing the BST or PZT of top dielectric layer 120 in Bai with the La_2O_3 dielectric material 14 of Callegari would frustrate an intended purpose of Bai that top dielectric layer 120 function to block any leakage current through bottom dielectric layer 130.

In addition, neither Bai nor Callegari disclose or suggest and the Office Action does not allege that they disclose or suggest that forming a hafnium-containing or lanthanum-containing dielectric layer includes initially forming a hafnium-containing or lanthanum-containing metal layer. A finding of obviousness requires disclosure or suggestion of every claim limitation. At least for such additional reason, claim 20 is patentable over Bai in view of Callegari.

Claims 23-26 and 29-31 depend from claim 20 and are patentable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested. For example, claim 23 sets forth that the method includes forming a layer of silicon dioxide prior to forming the hafnium-containing dielectric layer (which includes initially forming a hafnium-containing metal layer, as set forth in claim 20.) Pages 5-6 of the Office Action allege that interfacial oxide layer 12 described in Callegari discloses the subject matter of claim 23. However, Callegari does not disclose or suggest that interfacial oxide layer 12 is formed prior to forming a hafnium-containing dielectric layer by initially forming a hafnium-containing metal layer. At least for such reason, Callegari fails to disclose or suggest the subject matter relied upon in the Office Action.

Also for example, claim 24 sets forth that forming the hafnium-containing and lanthanum-containing dielectric layers further includes exposing the hafnium-containing and lanthanum-containing metal layers to an oxygen comprising atmosphere while heating the metal layers to a temperature effective to form hafnium-containing and lanthanum-containing dielectric layers. As may be appreciated from the discussion

above regarding the deficiencies of Bai and Callegari as applied to claim 8, the cited references also fail to disclose or suggest every limitation of claim 24.

Claim 3 sets forth a method of forming a dielectric layer that includes, among other features, forming a layer of silicon dioxide over a silicon-containing surface, forming a metal layer over the layer of silicon dioxide, heating the metal layer and layer of silicon dioxide to a temperature of from about 200° C to less than 400° C and combining metal of the metal layer with oxygen of the silicon dioxide layer to form a metal oxide dielectric material comprised by a first metal-containing dielectric layer, and forming a second metal-containing dielectric layer on and in contact with the first metal-containing dielectric layer. All of the metal of the first dielectric layer consists of at least one element selected from Group IVB and all the metal of the second dielectric layer consists of at least one element selected from Group IIIB. Page 6 of the Office Action alleges that, as discussed in the Office Action with regard to claim 1, 23, and 26, Bai and Callegari disclose all the limitations of claim 3. Applicant traverses.

As may be appreciated from the discussion above regarding the deficiencies of Bai and Callegari as applied to claims 1, 8, and 23, the cited combination fails to disclose every limitation of claim 3. For example, neither reference discloses or suggests forming a layer of silicon dioxide over a silicon-containing surface and forming a metal layer over the silicon dioxide where the metal layer is formed into a metal oxide dielectric material. Also, neither reference discloses or suggests and the Office Action does not allege that they disclose or suggest heating the metal layer and silicon dioxide

and combining metal of the metal layer with oxygen of the silicon dioxide layer to form the metal oxide dielectric material.

Further, as asserted above, combination of Callegari and Bai in the manner alleged by the Office Action frustrates an intended purpose of Bai. Accordingly, the cited combination cannot properly be considered to disclose or suggest the claimed second metal-containing dielectric layer including at least one Group IIIB element on and in contact with the first metal-containing dielectric layer containing at least on Group IVB element.

At least for the reasons indicated, the cited combination of references fails to disclose or suggest every limitation of claim 3. Claim 4 depends from claim 3 and is patentable at least for such reason as well as for the additional limitations of such claim not disclosed or suggested.

As may be appreciated from the discussions above regarding the deficiencies of Bai in view of Callegari as applied to the various claims, claims 52, 54, and 55 are also patentable.

Applicant's assertions herein establish that claims 1-4, 6-8, 13-15, 18-20, 23-26, 29-31, 52, 54, and 55 are patentable over Bai in view of Callegari. Applicant requests allowance of such claims in the next Office Action.

Claims 5 and 27 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Bai in view of Callegari and in further view of Kaushik. Applicant requests reconsideration.

Page 6 of the Office Action acknowledges that Bai and Callegari do not disclose the subject matter of claims 5 and 27 and relies upon Kaushik as allegedly resolving the deficiencies of such references. However, claim 5 depends from claim 3 and claim 27 depends from claim 20 the subject matter of which are discussed above. As asserted herein, the combination of Bai and Callegari is deficient in disclosing every limitation of claims 3 and 20. Kaushik does not remedy and is not alleged in the Office Action to remedy the deficiencies of Bai and Callegari in failing to disclose or suggest every limitation of claims 3 and 20. At least for such reason, further combination of the cited references with Kaushik cannot be considered to disclose or suggest every limitation of claims 5 and 27 depending respectively from claims 3 and 20.

In addition, page 6 of the Office Action incorrectly alleges that Kaushik discloses combining metal of the metal layer with oxygen of the silicon dioxide layer to form a metal oxide dielectric material, as set forth in claim 3 from which claim 5 depends. Column 3, lines 13-24 of Kaushik clearly describe that the combining of silicon dioxide and metal in Kaushik involves diffusing a metal layer into a silicon dioxide layer at a temperature of from about 400° C up to about 1000° C. In general, the result of diffusing metal into silicon dioxide is to form a silicate material as described in column 3, lines 36-40 of Kaushik. In contrast, the method of claim 3 sets forth combining metal of the metal layer with oxygen of the silicon dioxide layer to form a metal oxide. A metal oxide is patentably distinguished from a silicate material.

In addition, claim 3 sets forth heating the metal layer and silicon dioxide to a temperature of from about 200° C to less than 400° C. The diffusion step of Kaushik

thus occurs at a higher temperature compared to the heating in claim 3. Paragraph [0034] along with paragraphs [0025] and [0033] of the present specification describe that heating a metal layer and silicon dioxide to a temperature of from about 200° C to less than 400° C results in formation of a metal oxide. The heating in claim 3 may thus be contrasted with the higher temperature diffusion step of Kaushik that instead results in formation of a silicate material.

Kaushik thus fails to disclose forming a metal oxide dielectric material since it only describes forming a silicate material by a diffusion step. Kaushik also fails to disclose heating a metal layer and silicon dioxide at a temperature of from about 200° C to less than 400° C, as set forth in claim 3. Based on the express teachings of Kaushik, those of ordinary skill would find that failing to provide the higher temperatures described by Kaushik would prevent proper formation of the desired silicate material. Further, failure to provide the higher temperature diffusion step of Kaushik and form a silicate material would frustrate an intended purpose of Kaushik. Thus, no motivation can be deemed to exist to modify the express teachings of Kaushik and instead heat at a lower temperature to form a metal oxide dielectric material.

At least for the indicated reasons, the cited combination of references fail to disclose or suggest every limitation of claims 5 and 27. Applicant requests allowance of such claims in the next Office Action.

Claims 9, 16, 17, 21, and 22 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Bai in view of Callegari and in further view of Zhang. Applicant requests reconsideration.

Claims 9, 16, and 17 depend from claim 1 and claims 21 and 22 depend from claim 20. The subject matter of claims 1 and 20 is described above. Applicant herein establishes that Bai in view of Callegari fail to disclose or suggest every limitation of claims 1 and 20. Zhang does not remedy and is not alleged in the Office Action to remedy the deficiencies of Bai in view of Callegari as applied to claims 1 and 20. At least for such reason, claims 9, 16, 17, 21, and 22 depending from claims 1 or 20 are patentable. Applicant requests allowance of such claims in the next Office Action.

Applicant herein establishes adequate reasons supporting patentability of claims 1-31, 52, and 54-59 and requests allowance of all such pending claims in the next Office Action.

Respectfully submitted,

Date 19 Feb 2004 Signed _____

James E. Lake
Reg. No. 44,854